REMARKS

Claim Rejections 35 U.S.C. § 103 (a)

The Examiner has rejected claims 1-12 under 35 U.S.C. §103 (a) as being unpatentable over Casey, Jr. et al. (US 6,042,738).

Applicants respectfully disagree with the Examiner. In the opinion of the Examiner, the cited reference of Casey, Jr. et al. teaches that a particle beam encompasses ion beams, electron beams, neutral particle beams, x-ray beams and any other directed radiation suitable for imaging or etching a workpiece. See lines 8-11 in Col. 3.

However, Casey, Jr. et al. teaches a focused "particle" beam system that can precisely "mill" a work piece having an opaque film patterned on a substrate. See lines 4-7 in Col. 4 and Figure 1. Casey, Jr. et al. also teaches that scanning a focused beam of "particles" over a substrate surface "physically sputters" away substrate particles. See lines 11-13 and 41-42 in Col. 3. Furthermore, Casey, Jr. et al. considers "particle" and "ion" to be interchangeable and equivalent since Casey, Jr. et al. teaches a method using a focused "particle" beam ("FIB") system. See block 100 in Figure 7. Thus, Casey, Jr. et al. clearly teaches a focused particle beam system that always includes ions.

In particular, Casey, Jr. et al. teaches a focused ion beam (FIB) system (10) that includes an ion column (12), see lines 45-46 in Col. 4, a charge neutralization element (32), see line 4 in Col. 5, a secondary particle detector (28), see lines 5 in Col. 5, and a fluid delivery conduit (44), see lines 23-24 in Col. 5. Scanning a focused beam of ions over a mask with the apparatus of Casey, Jr. et al. will physically sputter away exposed portions of the surface of the mask. See lines 25-28 in Col. 1. When a gas is

also directed at the surface of the mask during FIB milling, the process is referred to as gas-assisted etching (GAE). See lines 58-60 in Col. 1.

In contrast, Applicants' invention envisions an apparatus for electron beam-induced chemical etching without any concurrent FIB milling. See lines 6-8 on page 12 of the specification and Figure 4. Thus, the apparatus of Applicants' invention is completely unlike the apparatus taught by Casey, Jr. et al. which always includes some milling or sputtering with ions. See lines 41-42 in Col. 3.

Applicants have amended claim 1 of Applicants' claimed invention. As claimed in claim 1, as amended, of Applicants' claimed invention, the apparatus (400) includes an imaging system (440), that may include an electron column, to locate an opaque defect (405) on the mask (410). See lines 12-14 on page 12 of the specification.

The apparatus (400) also includes a gas delivery system (450) to dispense one or more reactant gases from reservoirs, through one or more openings, such as nozzles, towards the opaque defect (405). See lines 15-17 on page 12 of the specification.

The apparatus further includes an electron delivery system (460) to direct electrons towards the opaque defect (405) and induce etching by the reactant gas. See lines 1-2 on page 14 of the specification. The electron delivery system (460) may resemble an electron column used to image a sample in a SEM except that the focusing and scanning controls for the electron beam are more sophisticated. See lines 23-25 on page 13 of the specification.

The apparatus of Applicants' invention may be used to repair an opaque defect on a transmissive DUV mask or a reflective EUV mask. Electron beam-induced chemical etching has high selectivity to underlying layers because it is essentially chemical, unlike FIB or GAE, as taught by Casey, Jr. et al., which always has a physical component due to ion bombardment. Unlike with the ion beam in FIB, an electron beam will not damage underlying layers by ion implantation or by knock-on of atoms. See lines 23-27 on page 9 of the specification.

Casey, Jr. et al. teaches an apparatus that includes ions for milling or sputtering, but does not teach, suggest, or render obvious the apparatus of Applicants' claimed invention, as claimed in claim 1, as amended, that includes an electron delivery system (460) to direct electrons towards the opaque defect (405) and induce etching by the reactant gas where the electrons include a tail diameter of about 5-125 nm. Thus, Applicants' claimed invention, as claimed in claim 1 would not be obvious to one of ordinary skill in the art of semiconductors.

Applicants have also amended claim 11 of Applicants' claimed invention. As claimed in claim 11, as amended, of Applicants' claimed invention, the apparatus (400) of claim 1, as amended, further includes an acceleration system to provide a low acceleration voltage for the electrons, where the low acceleration voltage includes a range of about 0.3-3.0 keV. See lines 9-10 on page 14 of the specification.

Claims 2-12 are dependent on claim 1, as amended. Thus, Applicants' claimed invention, as claimed in claims 2-12 would also not be obvious to one of ordinary skill in the art of semiconductors.

In view of the foregoing, Applicants respectfully request the Examiner to withdraw the rejections to claims 1–12 under 35 U.S.C. §103 (a).

Applicant believes that all claims pending, including claims 1-12, are now in condition for allowance so such action is earnestly solicited at the earliest possible date.